

## CLAIMS

We claim:

1. A method of producing a stream of charged particles in a low pressure environment that includes the following essential steps:
  - (a) supplying a flow of relatively non-volatile and relatively inviscid conducting liquid to a region at low pressure in which there is an electric field sufficiently intense to disperse said liquid into said low pressure region as a stream of small charged droplets and/or ions
  - (b) providing one or more electrodes having configurations, potentials and positions such that all or a selected part of said stream of small charged droplets and/or ions will flow in a desired direction at a desired velocity;
2. A method as in claim 1 in which the volatility of said liquid is low enough so that it does not boil or freeze when it enters said low pressure region.
3. A method as in claim 1 in which said liquid has a conductivity between 0.1 and 100 S/m.
4. A method as in claim 1 in which the properties of said liquid, the flow rate at which it is supplied into said low pressure region and the intensity of said electric field are such that the meniscus or interface between the liquid and said low pressure region assumes the well known cone-jet configuration in which a thin jet of liquid emerges from the tip of a so-called Taylor Cone whose base has lateral dimensions approximately equal to those of the exit cross sectional area of the duct from which said liquid emerges into said region containing said intense electric field.
5. A method as in claim 1 in which said relatively non-volatile conducting liquid comprises a solution of an electrolyte in a solvent chosen from the class of compounds that comprises amides, alcohols, glycols, esters, ketones, organic carbonates and phosphates and mixtures of one or more of these components.
6. A method as in claim 1 in which said relatively non-volatile conducting liquid is chosen from the class of compounds that includes ionic liquids, molten salts, and inorganic acids.
7. An apparatus for producing a stream of charged particles in a low pressure environment that includes the following essential elements:
  - (a) a reservoir or source of a relatively non-volatile conducting liquid of moderate viscosity,
  - (b) a region at reduced pressure exposed to an electric field,
  - (c) a means for supplying a flow of said relatively non-volatile conducting liquid from said source into said region containing said electric field at a controlled flow rate such that the field disperses the arriving liquid into a stream of charged droplets and/or ions,
  - (d) one or more electrodes at appropriate locations and appropriate potentials relative to those of the arriving liquid that will produce said electric field in said region and will steer the stream of charged particles produced in said region exposed to said electric field so that it flows in a desired direction at a desired velocity away from said region with said intense field,
  - (e) power supplies that will provide the voltages and currents necessary to maintain said

electrodes at said potentials such that said electric field will disperse electrostatically said liquid into said stream of charged particles.

8. An apparatus as in claim 7 including a vacuum pump to create said region at reduced pressure

9. An apparatus as in claim 7 including a means to control the temperature of said relatively non-volatile conducting liquid in said region containing said electric field

10. An apparatus as in claim 9 operating as a source primarily of ions, where said liquid at said controlled temperature has an electrical conductivity in excess of 3 S/m, and the largest dimension of the relatively non-volatile conducting liquid exposed to a low pressure environment is smaller than 20  $\mu\text{m}$ .

11. An apparatus as in claim 9 operating as a source primarily of ions, where said liquid at said controlled temperature is an ionic liquid, or a mixture including an ionic liquid, with an electrical conductivity in excess of 3 S/m.

12. An apparatus as in claim 11 operating as a source primarily of heavy ions, where either the anions or the cations composing said ionic liquid have mass/charge ratios in excess of 500 Dalton.